IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Jason L. Mitchell et al. Examiner: Robert N. Bader
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Title: **METHOD AND APPARATUS FOR OBJECT BASED VISIBILITY CULLING**

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REMARKS FOR PRE-APPEAL BRIEF REQUEST FOR REVIEW

Dear Sir:

Applicants respectfully submit that the Examiner's rejections include clear errors because the references fail to teach what is alleged and the references fail to teach the claimed subject matter.

Claims 11-16 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 6,295,461 (Brown) in view of "Designing a PC Game Engine" by L. Bishop, D. Eberly, T. Whitted, M. Finch and M. Shantz (Bishop).

Applicants respectfully submit clear error exists because the Brown reference renders an object before determining its visibility, whereas claim 11 recites making a determination regarding visibility based on a draw packet prior to rendering the draw packet. Claim 11 recites in part an apparatus that

> compares each of the plurality of draw packets to a bounding volume object, wherein the bounding volume object is a low resolution geometric representation of a specific object identified as geometry through which viewing definitions are defined;
> for each of the plurality of draw packets, if the draw packet is deemed potentially visible, sets a visibility query identifier for the draw packet, and using at least one of a plurality of identifiers that defines which of a plurality of hardware queries is to be updated; and
> renders one or more draw packets having the set visibility query identifier (Claim 11; emphasis added).

Brown does not teach at least the recited limitation of comparing draw packets to a bounding volume object. The Final Office Action dated March 4, 2011 (hereinafter the Office Action) alleges that

> The limitation "compares each of the plurality of draw packets to a bounding volume object, wherein the bounding volume is a low resolution geometric representation of a specific object" is taught by Brown (col 7, lines 13-25) (Office Action, pg. 8; emphasis added).

The cited portion of Brown reads:

> In similar fashion, when an application program 102 is configured to display a graphics scene that requires the rendering of relatively complex (i.e., computationally extensive) graphics shapes or objects, the application program 102 may be segmented by a developer to first send a relatively simplified version of the object or shape to be rendered to the graphics pipeline, and thereafter test the visibility of flag 110. If the visibility flag indicates that no part of the shape was rendered, then the application program 102 may skip over subsequent graphics calls that would further render the shape or object. In this way, otherwise unnecessary computations may be saved by selective and careful programming at the application program 102 level (Brown, col. 7 lns. 13-25; emphasis added).

It is respectfully submitted that the cited portion of Brown does not teach a comparison between draw packets and a bounding volume object as alleged. Rather, in the cited portion, Brown teaches that a "visibility flag" is set for a shape only after a first rendering pass on the shape has been completed. As taught by Brown, the visibility flag indicates that a shape has been successfully rendered. Rather than comparing draw packets to a bounding volume, Brown teaches subsequent rendering passes are prevented on objects that have been determined to be non-visible based on a previous rendering pass. In other words, Brown teaches a method whereby multiple passes are used to render objects; a first rendering pass is performed on every object of a graphic display while subsequent rendering passes are only performed on visible objects (see e.g. Brown, Figs. 5 & 6 and col. 8 ln. 31 – col. 9 ln. 42). Thus, the method taught by Brown is incapable of determining if a particular object will be non-visible without first completing a rendering pass. Further, as argued on pages 6-7 of the previous Response (dated February 15, 2011), Brown explicitly teaches that the visibility flag is only set when graphics data representing the object has been rendered and is transmitted to the frame buffer. For example, Brown states that

> when the application program 102 performs a graphics call that specifies a primitive to be filled on a "first pass", it may thereafter check the visibility flag 110 to see if, in fact, any portion of that primitive was sent to the frame buffer 108 for display (Brown, col. 7 lns. 1-5; emphasis added; see also Brown, col. 6 lns. 35-38 and 51-55).

As best understood, the Office Action alleges that "Brown explicitly indicates that there is an alternate way to control the visibility flag" aside from mechanism 112 and that this "alternate way" reads on Applicants' recited approach (Office Action, pg. 11). However, Applicants respectfully submit that the "alternate way" of setting the visibility flag is for rendering pipeline 106 to control mechanism 112 to set the visibility flag when graphics data is sent to the frame buffer for display (see e.g. Brown, col. 6 lns. 55-57). In other words, the visibility flag is set for an object when graphics data representing that object is sent to the frame buffer; this process can be controlled by either mechanism 112 or rendering pipeline 106. Accordingly, both alternatives require that an object must be rendered to the frame buffer before a determination can be made regarding its visibility.

In sharp contrast to Brown, Applicants recite an apparatus capable of evaluating the visibility of draw packets before they are rendered. Accordingly, a first rendering pass is not required on objects that will not be visible. For example, as discussed in Applicants' ¶ 0011, a bounding object through which viewing definitions may be defined (such as a window or doorway) can be used to determine whether draw packets are potentially visible. Thus, objects determined to be non-visible are not rendered (see e.g. Applicants' ¶¶ 0001 and 0016-0017). As is clear to one of ordinary skill in the art, Applicants' recited method offers several advantages over that taught by Brown, including for example reducing the amount of processing overhead required to display a graphics image by not conducting a first rendering pass on non-visible objects.

It is respectfully submitted that further clear error exists because Brown does not teach or suggest "draw packets" as recited by Applicants. For example, the Office Action alleges that "Brown's 'segments' correspond to Applicant's 'packets', which can represent any object segmentation scheme desired by a developer" (Office Action, pg. 12; emphasis added). More specifically, the Office Action alleged that

> The limitation "receives a plurality of draw packets" is taught by Brown (as indicated in col 3, lines 36-56, as quoted in the claim 21 rejection, graphics data is broken up into segments, i.e. the first segment, and others) (Office Action, pg. 8; emphasis added).

The cited portion of Brown reads:

> The method operates in a computer graphics system having an application program that interfaces through an application program interface (API) to a graphics pipeline, including a rendering pipeline and a frame buffer. The method

> includes the step of providing a visibility 40 flag that is in communication with the application program to relay rendering information to the application program. The method clears (or resets) the visibility flag upon sending new data to the rendering pipeline, and sets the visibility flag if data sent to the rendering pipeline from the application 45 program is further communicated to the frame buffer for display. Thereafter, the method evaluates the visibility flag from within the application program after a first pass of a first segment of graphics data has been rendered by the rendering pipeline. If the visibility flag was not set during 50 the first pass, then the application program inhibits the rendering of subsequent passes of the first segment of graphics data. If, however, the visibility flag was set during the first pass, then the application program will send subsequent passes of the graphics data to the rendering pipeline 55 for processing and display (Brown, col. 3 lns. 36-56; emphasis added).

As shown in the cited portion above, Brown does not teach or suggest draw packets. Instead, Brown merely describes how graphics data can be divided into multiple segments that can be separately sent to a rendering pipeline. For example, Brown describes these segments of graphics data by stating that

> when an application program 102 is configured to display a graphics scene that requires the rendering of relatively complex (i.e., computationally extensive) graphics shapes or objects, the application program 102 may be segmented by a developer to first send a relatively simplified version of the object or shape to be rendered to the graphics pipeline… (Brown, col. 7 lns. 13-19).

Accordingly, it is respectfully submitted that as best understood, Brown teaches that the "segments of graphics data" comprise simplified versions of objects or shapes. In other words, Brown necessarily makes determinations regarding visibility on a rendered object or shape level. In sharp contrast thereto, Applicants explicitly recite using draw packets prior to rendering as a basis for determining whether a draw packet is potentially visible and should be rendered.

Claims 21, 2, 3, 5 and 6 stand rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by Brown. Applicants respectfully reassert the relevant remarks made above and as such, there is clear error with regard to these claims as well.

Claim 20 stands rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Brown as applied to claim 3 above and further in view of "ARB_occlusion_query" by R. Cunniff, M. Craighead, D. Ginsburg, K. Lefebvre, B. Licea-Kane, and N. Triantos (Cunniff). Applicants respectfully reassert the relevant remarks made above and as such there is clear error with regard to these claims as well.

Withdrawal of the rejections of the claims is respectfully requested due to at least one or more clear errors by the Examiner, and a Notice of Allowance is respectfully requested.

Respectfully submitted,

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By: /Christopher J. Reckamp/
Christopher J. Reckamp
Registration No. 34,414

Vedder Price P.C.
222 North LaSalle Street, Suite 2600
Chicago, Illinois 60601
phone: (312) 609-7599
fax: (312) 609-5005